FOREST PRODUCTS
Project Fact Sheet

HIGH EFFICIENCY CHLORINE DIOXIDE DELIGNIFICATION

BENEFITS

- 10 percent less CLO_2 needed to treat softwood kraft pulp; 25 percent less for hardwood kraft pulp
- Reduced generation of AOX compounds
- Generation of more benign AOX (low chlorine content per atom)
- Reduced energy use
- Reduced energy use
- Lower production costs
- Improved understanding about the fundamental chemistry of ClO_2 delignification

APPLICATIONS

The results of this research will be used to further improve the delignification of kraft pulps by industry using elemental chlorine-free bleaching processes

Fundamental Knowledge of Bleaching Process Will Improve Paper Industry's Environmental Performance

As environmental regulations and consumer activism have increased in recent years, few issues have drawn more attention than the use of elemental chlorine in pulp and paper bleaching operations. The chlorination/extraction process has been found to be the major source of dioxins, furans, and adsorbable organic halides (AOX), which are produced in very small but detectable amounts. Two processing changes have been rapidly incorporated into pulping operations to help the industry meet more stringent environmental standards: extending the pulping process to yield kraft pulps containing low levels of lignin (and therefore lower bleaching requirements), and using alternative bleaching agents such as chlorine dioxide (ClO_2).

However, the fundamental principles behind the effects of these processing changes on the bleaching process are not well understood, and an objective of this project is to develop a greater understanding of how chlorine dioxide delignification of low-kappa kraft pulps occurs. New methods are also needed to improve the efficiency and effectiveness of the bleaching agent. More knowledge about the basic chemical reactions involved in ClO_2 delignification will lead to an improved, more economical process for industry.

OFFICE OF INDUSTRIAL TECHNOLOGIES
ENERGY EFFICIENCY AND RENEWABLE ENERGY • U.S. DEPARTMENT OF ENERGY

PROJECT DESCRIPTION

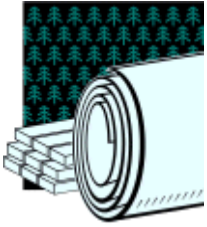
Goal: To develop a fundamental understanding about the chemistry of chlorine dioxide delignification of low-kappa kraft pulps, and to develop a high-efficiency, low-capital, environmentally sound bleaching process for pulp and paper operations.

In the first year of this two-year effort, typical kraft pulps will be prepared and characterized for their yield, kappa number, viscosity, and TAPPI brightness. The residual lignin in the pulps will be isolated with specialized enzymatic and chemical methods and its structure determined with such techniques as nuclear magnetic resonance and molecular-weight (M-W) distributions. These data will help identify residual-lignin structures that enhance or retard ClO_2 delignification. The pulps will then be bleached under conventional Do, rapid Do, and vapor phase ClO_2 and (EO) bleaching conditions, and characterized for standard bleaching parameters. The structure of residual lignin in ClO_2-bleached pulps and effluents will be determined, using advanced spectroscopic techniques and M-W distributions.

Tasks in the second year will include determining the structure of residual lignin in (EO) pulps, again using advanced spectroscopic techniques and M-W distributions. The concentration of hexenuronic acids present in industrial and laboratory-prepared kraft pulps will also be measured, and hydrolysis methods will be developed to pretreat kraft pulps to remove these hexenuronic acids. The hexenuronic acid-free pulps will then be bleached with ClO_2 to verify it is advantageous to remove the acid from kraft pulps prior to a Do stage. The final task will be to develop optimal, high-efficiency delignification technologies using ClO_2.

PROGRESS & MILESTONES

- At the end of the first year, a model will be developed for high-efficiency ClO_2 delignification.
- In the second year, the model for high-efficiency ClO_2 delignification will be tested to determine if it is predictive.



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